AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions and listings of claims in the application.

LISTING OF CLAIMS

1. (Currently Amended) A digital signal processing system for symmetrical stereophonic image enhancement in an automotive listening environment, comprising:

input ports receiving stereo input signals from a stereo signal source;

output ports providing left and right stereo output signals;

a digital signal process interconnected between the input ports and the output ports, the digital signal process having left and right signal paths and further includes

a phase shift device interposed into only one of the left and right signal paths and operative to insert a rapid rate-of-change phase shift to a maximum of substantially 180 degrees into the corresponding stereo signal; and

a time delay device interposed into the remaining signal path and operative to introduce a time delay into the corresponding stereo signal.

2. (Previously Presented) The digital signal processing system of Claim 1 wherein the phase shift device is operative to insert the rapid rate-of-change phase shift at substantially 200 Hertz.

3. (Previously Presented) The digital signal processing system of Claim 1 wherein the phase shift device is operative to insert the rapid rate-of-change phase shift at a frequency within the range of 100 to 400 Hertz.

4. (Original) The digital signal processing system of Claim 1 wherein the digital signal process further includes an adjustable clock, such that the frequency of the clock determines the frequency at which rapid rate-of-change phase shift occurs.

5. (Previously Presented) The digital signal processing system of Claim 1 wherein the digital signal process is implemented using a digital circuit and the time delay is equal to a constant time delay component associated with the digital circuit of the phase shift device.

6. (Previously Presented) The digital signal processing system of Claim 1 further comprising a spatial enhancement component interposed between the input ports and the digital signal process.

7. (Previously Presented) The digital signal processing system of Claim 6 wherein the spatial enhancement component further comprises:

a first differential amplifier receiving a left stereo input signal and operative to generate a left minus right (l-r) difference signal;

a first equalizer having a step function, the first equalizer receiving the l-r difference signal and operative to generate an equalized l-r difference signal;

a first attentuator receiving the equalized l-r difference signal and operative to generate an attentuated l-r difference signal; and

a first summer receiving the left stereo input signal and the attentuated l-r difference signal and operative to generate a spatially enhanced left channel signal.

8. (Previously Presented) The digital signal processing system of Claim 6 wherein the spatial enhancement component further comprises:

a second differential amplifier receiving a right stereo input signal and operative to generate a right minus left (r-l) difference signal;

a second equalizer having a step function, the second equalizer receiving the r-l difference signal and operative to generate an equalized r-l difference signal;

a second attentuator receiving the equalized r-l difference signal and operative to generate an attentuated r-l difference signal; and

a second summer receiving the right stereo input signal and the attentuated r-l difference signal and operative to generate a spatially enhanced right channel signal.

9. (Previously Presented) The digital signal processing system of Claim 1 further comprising a summing circuit receiving the left and right stereo output signals from the output ports and operative to generate a summed output signal suitable for input to a low frequency subwoofer speaker.

10. (Previously Presented) The digital signal processing system of Claim 1 wherein the phase shift device further comprises a non-inverting high-order low-pass filter,

a 90-degree phase shifted narrow band-pass filter, and an inverting high-order high-pass filter, where each of the filters receives the same stereo input signal and generates a corresponding filtered output signal; and a signal summer receives the filtered output signal from each of the filters and generates a summed output signal, thereby providing a rapid rate-of-change phase shift to a maximum of 180-degree in the corresponding stereo signal.

11. (Previously Presented) The digital signal processing system of Claim 1 wherein the phase shift device is further defined as a non-inverting high-order low-pass filter and an inverting high-order high-pass filter, where each of the filters receives the same stereo input signal and generates a corresponding filtered output signal; and a signal summer receives the filtered output signal from each of the filters and generates a summed output signal, thereby providing a rapid rate-of-change phase shift to a maximum of 180-degrees in the corresponding stereo signal.

12. (Previously Presented) The digital signal processing system of Claim 1 wherein the phase shift device further comprises a non-linear time delay component that is operative to introduce a time delay that varies inversely with frequency above substantially 200 hertz and a constant time delay below substantially 200 hertz.

13. (Previously Presented) The digital signal processing system of Claim 1 wherein the phase shift device further comprises a digital high-Q all-pass filter that is

operative to insert a rapid rate-of-change phase shift to a maximum of 180 degrees into the corresponding stereo signal.

14. (Previously Presented) The digital signal processing system of Claim 13 wherein the all-pass filter is defined as having a Q greater than one.

15. (Previously Presented) The digital signal processing system of Claim 1 wherein the phase shift device further comprises a digital high-order all-pass filter that is operative to insert a rapid rate-of-change of phase to a maximum of n(180) degrees, where n equals an odd integer greater than 1 such that the phase shift remains substantially 180 degrees.

16. (Previously Presented) The digital signal processing system of Claim 1 wherein the phase shift device further comprises a conventional all-pass filter having a positive phase shift function, and a non-causal all-pass filter having a time displaced negative phase shift function, wherein the positive phase shift function and the negative shift function operate sequentially, thereby providing a rapid rate-of-change phase shift to a maximum of 180-degrees in the corresponding stereo signal.

17. (Previously Presented) A digital signal processing system for symmetrical stereophonic image enhancement in an automotive listening environment, comprising:

input ports receiving stereo input signals from a stereo signal source;

output ports providing left and right stereo output signals;

a digital signal process interconnected between the input ports and the output ports, the digital signal process having left and right signal paths and further includes

a first digital high-Q all-pass filter interposed into one of the left and right signal paths and operative to insert a rapid rate-of-change phase shift into the corresponding stereo signal; and

a second digital high-Q all-pass filter interposed into the remaining signal paths and operative to insert a rapid rate-of-change phase shift into the corresponding stereo signal, wherein a rapid rate-of-change phase shift to a maximum of 180 degrees is provided between the stereo signals.

18. (Previously Presented) The digital signal processing system of Claim 17 wherein at least one of the first all-pass filter and the second all-pass filter is operative to insert the rapid rate-of-change phase shift at substantially 200 Hertz.

19. (Previously Presented) The digital signal processing system of Claim 17 wherein at least one of the first all-pass filter and the second all-pass filter is operative to insert the rapid rate-of-change phase shift at a frequency within the range of 100 to 400 Hertz.

20. (Previously Presented) The digital signal processing system of Claim 17 wherein at least one of the first all-pass filter and the second all-pass filter further comprises a digital high-order all-pass filter that is operative to insert a rapid rate-of-

change of phase to a maximum of n(180) degrees, where n equals an odd integer greater than 1 such that the phase shift remains substantially 180 degrees.

21. (Previously Presented) The digital signal processing system of Claim 17 wherein the first all-pass filter further comprises a conventional all-pass filter having a positive phase shift function, and the second all-pass filter further comprises a non-causal all-pass filter having a time displaced negative phase shift function, thereby providing a rapid rate-of-change phase shift to a maximum of 180-degrees between the stereo signals.

22. (Previously Presented) The digital signal processing system of Claim 17 wherein at least one of the first digital high-Q all-pass filter and the second digital high-Q all-pass filter is defined as having a Q greater than one.

23. (Previously Presented) The digital signal processing system of Claim 17 wherein the digital signal process further comprises a time delay component interposed into one of the left and right signal paths and operative to introduce a time delay into the corresponding stereo signal that is equal to a constant time delay difference component between the first all-pass filter and the second all-pass filter.

24. (Currently Amended) A method for providing symmetrical stereophonic image enhancement in an automotive listening environment, comprising the steps of:

receiving a first channel input signal and a second channel input signal from a stereo signal source;

introducing a rapid rate-of-change phase shift to a maximum of substantially 180 degrees into only the first channel signal;

introducing a time delay into the second channel signal; and

providing as output the first and second channel signals to output ports, thereby providing a symmetrical stereophonic image enhancement in the automotive listening environment.

25. (Previously Presented) The method of Claim 24 wherein the step of introducing a rapid rate-of-change phase shift further comprises inserting the phase shift at substantially 200 Hertz.

26. (Previously Presented) The method of Claim 24 further comprising the step of adjusting the frequency at which the rapid rate-of-change phase shift is inserted into the first channel signal within a range of 100 to 400 Hertz.

27. (Previously Presented) The method of Claim 24 further comprising the step of providing a digital signal processing circuit interposed between the stereo signal source and the output ports for performing the steps of introducing a rapid rate-of-change phase shift and introducing a time delay.

28. (Currently Amended) The method of Claim 27 wherein the time delay is equal to the duration of the phase shift occurring in the first channel signal ~~a constant time delay introduced into the first channel signal by the presence of the digital signal processing circuit~~.

29. (Previously Presented) The method of Claim 24 further comprising the step of spatially enhancing the first channel input signal and the second channel input signal prior to the steps of introducing a rapid rate-of-change phase shift and introducing a time delay.

30. (Previously Presented) The method of Claim 29 wherein the first channel signal is further defined as a left stereo signal, the second channel signal is further defined as a right stereo signal, and the step of spatially enhancing further comprises:

deriving a left-minus-right (l-r) difference signal;

equalizing the l-r difference signal;

attenuating the equalized l-r difference signal; and

summing the attenuated l-r difference signal with the left side stereo signal, thereby generating a spatially enhanced left channel signal.

31. (Previously Presented) The method of Claim 29 wherein the first channel signal is further defined as a left side stereo signal, the second channel signal is further defined as a right side stereo signal, and the step of spatially enhancing further comprises:

deriving a right-minus-left (r-l) difference signal;

equalizing the r-l difference signal;

attenuating the equalized r-l difference signal;

summing the attenuated r-l difference signal with the right side stereo signal, thereby generating a spatially enhanced right channel signal.

32. (Currently Amended) The method of Claim 24 further comprising the step of summing the first channel signal and the second channel signal from the output ports, thereby generating a summed output signal suitable for input to a subwoofer speaker.

33. (Currently Amended) A method for providing symmetrical stereophonic image enhancement in an automotive listening environment, comprising the steps of:

receiving a first channel input signal and a second channel input signal from a stereo signal source;

introducing a rapid rate-of-change phase shift exclusively in the first channel signal ~~and a rapid rate-of-change phase shift to the second channel signal~~, thereby providing a rapid rate-of-change phase shift to a maximum of 180 degrees between the channels; and

providing as output the first and second channel signals to output ports, thereby providing a symmetrical stereophonic image enhancement in the automotive listening environment.

34. (Previously Presented) The method of Claim 33 wherein the step of introducing a rapid rate-of-change phase shift further comprises inserting the phase shift at substantially 200 Hertz.

35. (Previously Presented) The method of Claim 33 further comprising the step of adjusting the frequency at which the rapid rate-of-change phase shift is inserted into the first channel signal within a range of 100 to 400 Hertz.

36. (Previously Presented) The method of Claim 33 further comprising the step of introducing a time delay into at least one of the first channel signal and the second channel signal, such that the time delay is equal to a constant time delay difference between the channels.